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Instruction Manual
for the
Pulse Generator
Type No. OPS100c

THE SOLARTRON ELECTRONIC GROUP LTD
Thames Ditton, Surrey, England

MP MASTER
MA24433

INST.NO. OPS 100C. ISSUE NO. 3

AMEND NO. 1 MOD REF. 100/51

DATE APRIL 1960.

REASON FOR CHANGE

Morganite type R. resistors are now unobtainable.

DETAILS OF CHANGE

Changes are to resistor types, tolerances and ratings. The table below shown the new information.

CCT. REF.	Value	Tol.	Rating Watts	Solartron Part No.	Manufacturer and Type	
R3	22K	5	2	235641	Welwyn	F5 MF.
R20	1000	5	2	235625	Welwyn	F5 MF.
R22	100K	2	1	235397	Welwyn	Welmet
R23	100K	2	1	235397	Welwyn	Welmet
R24	100K	2	1	235397	Welwyn	Welmet
R33	27K	2	1	235383	Welwyn	Welmet
R51	100K	2	1	235397	Welwyn	Welmet
R55	100K	2	1	235397	Welwyn	Welmet

SOLARTRON

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THAMES DITTON · SURREY ENGLAND

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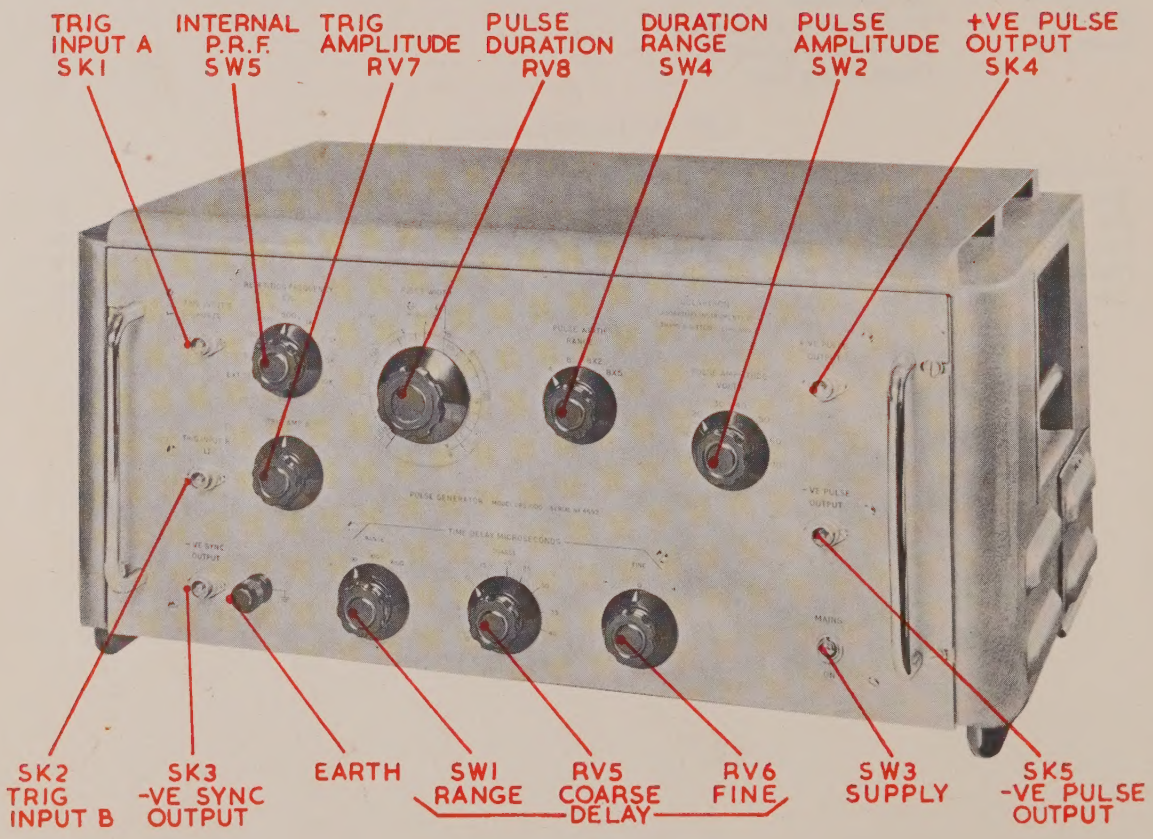


Frontispiece. The OPS100C Pulse Generator

SECTION 1

OPERATING INSTRUCTIONS

Before connecting the instrument to the power supply, check that the mains voltage selector panel is correctly set.

Switch on the instrument and allow a few minutes for warming up. Adjust pulse duration and delay as required.

Connect the pre-pulse to the sync/trig input of an oscilloscope monitor. Connect the pulse output to the work and adjust the pulse amplitude.

When running from an external trigger source, connect the external trigger into the correct socket according to polarity.

NOTE:-

The unit should not operate at a duty cycle greater than 0.5 as otherwise loss of amplitude will result.

SECTION 2

SPECIFICATION

Pulse Width

Continuously variable from 1 - 250 microseconds, in four ranges. Direct reading panel control.

Pulse Amplitude

Positive output pulses adjustable from 1 - 100 volts in steps of 10 volts. Impedance 140 ohms or less, depending on setting of attenuator control. Negative output of 10 volts on a separate socket when the attenuator control is set to 1.

NOTE:-

The Pulse duration and amplitude controls are most accurate at a pulse repetition frequency of 1000 pulses per second.

Pulse Shape

Rise time less than .1 microseconds from 10% to 90% of the amplitude.

Pulse Delay

Main pulse delayable 2 - 4,000 microseconds from sync. output pulse.

External Trigger Repetition Rates

With a sine wave input, 100 - 50,000 c/s, Min input 2 volts.

With positive or negative pulse or square wave input, 1 - 50,000 pps. Min input 2 volts.

Internal Trigger

8 spot frequencies of 50, 100, 250 and 500 c/s and 1, 2.5, 5 and 10 Kc/s. Frequency Accuracy ± 20%.

Sync Output

A 10 volt negative pulse from low impedance source approximately 2 microseconds in width.

Mains Supply

The instrument is designed for operation on AC mains, 200 - 250 volts, 40 - 60 c/s.

Dimensions

The instrument is built on a 19" rack mounting panel $8\frac{3}{4}$" high. It is supplied in a bench mounting case with overall dimensions $22\frac{1}{2}$" x $10\frac{1}{2}$" x $14\frac{1}{4}$" deep.

Weight

66 lbs. (30Kgs.)

Accessories

The instrument is supplied complete with three coaxial leads terminated with Belling and Lee coaxial plugs at one end and crocodile clips at the other.

SECTION 3

PRINCIPLES OF OPERATION

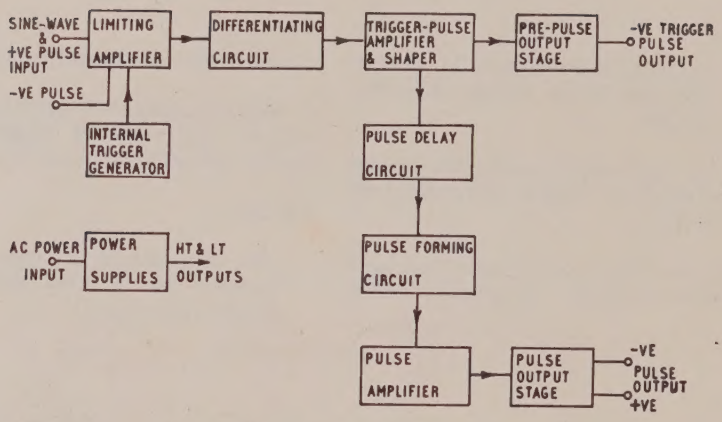


Fig. 1. Block Diagram

The operation of the pulse generator is best described in ten sections as follows:-

1. Internal trigger generator.
2. Limiting amplifiers.
3. Differentiating circuit.
4. Trigger pulse amplifier and shaper.
5. Pre-pulse output stage.
6. Pulse delay circuit.
7. Pulse forming circuit.
8. Pulse amplifier.
9. Pulse output stage.
10. Power supplies.

Internal Trigger Generator

This uses two halves of a 12AT7 (V13) connected as a Multivibrator. The repetition rate is varied by selecting various timing capacitors through SW5C and SW5D. To avoid excessive assymmetry of the circuit the value of the second timing capacitor is varied once throughout the range by SW5B. SW5A selects internal or external trigger.

Limiting Amplifiers

V1A, V1B and V2A are three amplifiers in cascade. A sine wave or +ve pulse fed to the grid of V1A through VR7 will be amplified and appear at the anode as a large amplitude sine wave or -ve pulse. The -ve pulse input is connected to this point so that V1B will receive any one of four possible signals:-

1) Large amplitude sinewave
2) -ve pulse from V1A
3) -ve pulse from -ve pulse input
4) Internal trigger signal

V1B has no bias, and will clip the positive half-cycles of sine wave by grid current and the negative half-cycles by cutting off. The output at the anode of V1B takes the form of a 50-50 square wave or a positive pulse. This signal is again amplified in V2A and the fall time of the signal at the anode of V2A is quite fast.

Differentiating Circuit

This consists of C6 and R9 and forms a high pass circuit which will pass the fast rise and fall of the square wave but not the L. F. component.

Trigger Pulse Amplifier and Shaper

The output of the differentiating circuit is fed into the grid of V2B. This signal consists of -ve going and +ve going pulses both of which are amplified.

The amplified pulses at the anode of V2B are coupled to the grid of V3A, an amplifier which is normally cut off. Thus the +ve pulses at the anode of V2B are amplified while the -ve pulses are rejected.

Pre-pulse Output Stage

The -ve pulse output from V3A anode is coupled into grid of V6, a cathode follower which provides a 10V 2μsec -ve going pre-pulse at the -ve SYNC OUTPUT socket.

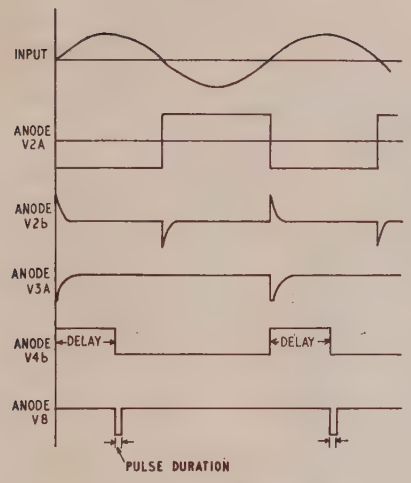


Fig. 2. Ideal Waveforms

Pulse Delay Circuit

V3B is normally cut off and its anode therefore is quiescent at H. T. The -ve trigger pulse is injected into the cathode of this valve causing its anode to fall. This -ve going step function is applied to the grid of V5A, resulting in a fall in the potential of V5A cathode. This fall in potential is coupled through one of the delay timing capacitors C11, C12, C13, on to the grid of V4B cutting it off. This causes the cathode of V4B to move negative and permits V4A to conduct, holding the anode of V3B negative. The timing capacitors recharge through VR5 and VR6 until V4B commences to conduct when the system regeneratively resumes its quiescent state.

V5B in conjunction with VR2, VR3 and VR4 sets the potential to which the timing capacitors are recharged.

The period of delay is controlled by the settings of VR5, VR6 and the timing capacitor in use. The output from this stage is taken from the anode of V4B which goes +ve at the commencement of the delay and returns -ve at the end of it.

Pulse Forming Circuit

The pulse forming circuit consists of V7 and V8. The rectangular wave from V4B anode is differentiated in VC1 and R26 and the negative pulse coinciding with the trailing edge of the rectangular wave cuts V7 off. This removes the bias from V8 and the resultant fall in the anode potential of V8 is coupled back to the suppressor grid of V7 holding it cut off. This condition remains while the relevant timing capacitor selected by SW4 is discharged through R52 or R53 and VR8.

At the end of the timing period the circuit regeneratively resumes its stable state.

Pulse Amplifier

The negative going output pulse from the anode of V8 is amplified in V10 and appears at the anode as a positive pulse with a fast rise time.

Pulse Output Stage

The pulse from the anode of V10 is coupled into V11 a cathode follower with a variable cathode load. This gives a very low impedance output at various levels.

A Resistor in the anode circuit provides a negative going pulse of 10V P-P amplitude when the cathode load is set at minimum.

Power Supplies

The power is drawn from the mains through a transformer.

H. T. is obtained from a centre tapped winding by full wave rectification through V12. CH2 is a swinging choke which is followed by a filter consisting of CH1, C23 and C24.

Heaters are obtained from suitable secondary windings on the transformer.

SECTION 4

SERVICING INFORMATION

To extract the instrument from its case, remove the four HEX headed chrome plated screws at the edges of the front panel; open the door on the right hand side of the case. Withdraw the instrument from the case.

The following list of test voltages is given as an aid to servicing. These potentials are typical and should not be treated as mandatory requirements.

The readings were taken with an Avo Model 8, having its -ve lead attached to frame.

The controls were set for external triggering, but no trigger was applied. Pulse duration, delay and amplitude were set to minimum.

Test Point		Reading (volts)	Range
V1A	Cathode	4.3	10
	Anode	145	250
V1B	Anode	80	250
V2A	Anode	75	250
V2B	Cathode	7	10
	Anode	195	250
V3A	Cathode	15	25
	Anode	235	250
V3B	Cathode	10.5	25
	Anode	145	250
V4B	Cathode	12	25
	Anode	95	250
V5A	Cathode	150	250
V5B	Cathode	13	25
V6	Cathode	30	100
V7	Anode	42	100
V8	Anode	235	250
	Cathode	52	100
V10	Anode	90	100
V11	Cathode	0.1	2.5
V13A	Anode	60	100
V13B	Anode	33	100
H.T. + C23		235	250
H.T. + (500 A) (Fuse)		290	1000
Wiper VR1		145	250
Across R49		-23	25

Circuit Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer & Type	
R1	100K	10	$\frac{1}{4}$	226349	Erie	16 Carbon
R2	1000	10	$\frac{1}{4}$	226325	Erie	16 Carbon
R3	22K	5	1	228741		
R4	100K	10	$\frac{1}{4}$	226349	Erie	16 Carbon
R5	47K	10	$\frac{1}{4}$	226345	Erie	16 Carbon
R6	22K	10	$\frac{1}{4}$	226341	Erie	16 Carbon
R7	100K	10	$\frac{1}{4}$	226349	Erie	16 Carbon
R8	22K	20	2	N22264	Erie	2 Carbon
R9	2200	10	$\frac{1}{4}$	226329	Erie	16 Carbon
R10	10K	10	$\frac{1}{4}$	226337	Erie	16 Carbon
R11	2200	10	$\frac{1}{4}$	226329	Erie	16 Carbon
R12	100K	10	$\frac{1}{4}$	226349	Erie	16 Carbon
R13	47K	20	2	N22265	Erie	2 Carbon
R14	3300	10	$\frac{1}{4}$	226331	Erie	16 Carbon
R15	470	10	$\frac{1}{4}$	226321	Erie	16 Carbon
R16	180K	10	$\frac{1}{4}$	226352	Erie	16 Carbon
R17	47K	10	$\frac{1}{4}$	226345	Erie	16 Carbon
R18	15K	10	$\frac{1}{4}$	226339	Erie	16 Carbon
R19	10K	10	$\frac{1}{4}$	226337	Erie	16 Carbon
R20	1000	5	1	228725		
R21	4700	20	2	N22266	Erie	2 Carbon
R22	100K	5	1	228749		
R23	100K	5	1	228749		
R24	100K	10	$\frac{1}{4}$	226349	Erie	16 Carbon
R25	10K	10	$\frac{1}{4}$	226337	Erie	16 Carbon
R26	1000	10	$\frac{1}{4}$	226325	Erie	16 Carbon
R27	2200	10	$\frac{1}{4}$	226329	Erie	16 Carbon
R28	330	10	$\frac{1}{4}$	226319	Erie	16 Carbon
R29	2200	10	$\frac{1}{4}$	226329	Erie	16 Carbon
R30	10K	5	$4\frac{1}{2}$	N22058	Painton	P301A W.W.
R31	100K	10	$\frac{1}{4}$	226349	Erie	16 Carbon
R32	4700	5	3	238445	Painton	P306A W.W.
R33	27K	5	1	228742		
R34	10	10	$\frac{1}{4}$	226301	Erie	16 Carbon
R35	1300	5	18	N22263	Painton	PX2001/B1 W.W
R36	10	10	$\frac{1}{4}$	226301	Erie	16 Carbon
R37	220K	10	$\frac{1}{4}$	226353	Erie	16 Carbon
R38	10	10	$\frac{1}{4}$	226301	Erie	16 Carbon
R39	22	10	$\frac{1}{4}$	226305	Erie	16 Carbon
R40	47	10	$\frac{1}{4}$	226309	Erie	16 Carbon
R41	68	10	$\frac{1}{4}$	226311	Erie	16 Carbon
R42	47	10	$\frac{1}{4}$	226309	Erie	16 Carbon
R43	47	10	$\frac{1}{4}$	226309	Erie	16 Carbon
R44	33	10	$\frac{1}{4}$	226307	Erie	16 Carbon
R45	33	10	$\frac{1}{4}$	226307	Erie	16 Carbon
R46	22	10	$\frac{1}{4}$	226305	Erie	16 Carbon
R47	10	10	$\frac{1}{4}$	226301	Erie	16 Carbon
R48	10K	5	$4\frac{1}{2}$	N22058	Painton	P301A W.W.
R49	100	5	$4\frac{1}{2}$	N22267	Painton	P301A W.W.
R50	4700	10	$\frac{1}{4}$	226333	Erie	16 Carbon

Circuit Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer & Type	
R51	100K	5	1	228749		
R52	47K	2	1/8	221165	Erie	109 H.S.
R53	100K	2	1/8	221173	Erie	109 H.S.
R54	470K	5	1/8	N22262	Erie	109 H.S.
R55	100K	5	1	228749		
R56	2.2M	10	1/4	226365	Erie	16 Carbon
R57	470K	5	1/8	N22262	Erie	109 H.S.
R58	100K	10	1/4	226349	Erie	16 Carbon
R59	100K	10	1/4	226349	Erie	16 Carbon
R60	10	10	1/4	226301	Erie	16 Carbon
R61	68	10	1/4	226311	Erie	16 Carbon
R62	100	10	1/4	226313	Erie	16 Carbon
R63	150	10	1/4	226315	Erie	16 Carbon
R64	470	10	1/4	226321	Erie	16 Carbon
R65	10M	10	1/4	226373	Erie	16 Carbon
R66	10	10	1/4	226301	Erie	16 Carbon
R67	10	10	1/4	226301	Erie	16 Carbon
RV1	5000				Reliance	TW/1 W.W.
RV2	50K				Reliance	TW/1 W.W.
RV3	50K				Reliance	TW/1 W.W.
RV4	50K				Reliance	TW/1 W.W.
RV5	2M	20	3/4		Morgan	H Carbon
RV6	100K	20	3/4	251558	Morgan	LH Carbon
RV7	100K	20	3/4	N25025		H Carbon
RV8	500K				Reliance	P1W/2 W.W.

Circuit Ref.	Value µFd	Tol. %	Rating Volts	Solartron Part No.	Manufacturer & Type	
C1	.05	20	500	214206	T.C.C.	CP37S Pa
C2	.05	20	500	214206	T.C.C.	CP37S Pa
C3	.1	20	350	214105	T.C.C.	CP45N Pa
C4	.05	20	500	214206	T.C.C.	CP37S Pa
C5	.05	20	500	214206	T.C.C.	CP37S Pa
C6	47pf	10	500	217611	Suflex	H.S. Po
C7	.1	20	350	214105	T.C.C.	CP45N Pa
C8	.05	20	500	214206	T.C.C.	CP37S Pa
C9	.1	20	350	214105	T.C.C.	CP45N Pa
C10	.01	20	350	214102	T.C.C.	CP32N Pa
C11	.01	20	350	214102	T.C.C.	CP32N Pa
C12	.001	5	500	N20171	Suflex	H.S. Po
C13	200pf	10	350	N20183	T.C.C.	CSM20N M.S.M.
C14	.1	20	350	214105	T.C.C.	CP45N Pa
C15	.05	20	500	214206	T.C.C.	CP37S Pa
C16	.1	20	350	214105	T.C.C.	CP45N Pa
C17	1	20	350	N20184	T.C.C.	CP91N Pa
C18	.05	20	500	214206	T.C.C.	CP37S Pa
C19	1	20	350	N20184	T.C.C.	CP91N Pa
C20	.5	20	350	N20185	T.C.C.	CP47N Pa
C21	330pf	10	350	N20118	T.C.C.	CSM20N M.S.M.
C22	50	-20 +50	50	N20170	T.C.C.	CE61D El
C23	32	-20 +50	450	N20055	T.C.C.	CE37P El
C24	16	-20 +50	500	N20054	T.C.C.	CE14P El
C25	100pf	5	500	N20174	Suflex	H.S. Po
C26	500pf	10	350	N20182	T.C.C.	CSM20N M.S.M.
C27	47pf	10	500	217611	Suflex	H.S. Po
C28	.01	20	350	214102	T.C.C.	CP32N Pa
C29	39pf	5	500	N20172	Suflex	H.S. Po
C30	.5	20	500	N20025	T.C.C.	CP91S Pa
C31	390pf	5	500	N20173	Suflex	H.S. Po
C32	33pf	5	500	N20177	Suflex	H.S. Po
C33	100pf	5	500	N20174	Suflex	H.S. Po
C34	270pf	5	500	N20175	Suflex	H.S. Po
C35	820pf	5	500	N20176	Suflex	H.S. Po
C36	.001	5	500	N20171	Suflex	H.S. Po
C37	.0027	5	500	N20178	Suflex	H.S. Po
C38	.0082	5	500	N20179	Suflex	H.S. Po
C39	.02	5	500	N20180	Suflex	H.S. Po
C40	50pf			N24404	Wingrove & Rogers	C8-03 trim
C41	4.8/97.2pf			N24403	Wingrove & Rogers	C8-03 trim
C42	4.8/97.2pf			N24403	Wingrove & Rogers	C8-03 trim
C43	4.8/97.2pf			N24403	Wingrove & Rogers	C8-03 trim
C44	4.8/97.2pf			N24403	Wingrove & Rogers	C8-03 trim

Circuit Ref.	Description	Solartron Part No.	Manufacturer & Type	
V1	Double triode		S. T. C.	6SN7GT
V2	Double triode		S. T. C.	6SN7GT
V3	Double triode		S. T. C.	6SN7GT
V4	Double triode		S. T. C.	6SN7GT
V5	Double triode		S. T. C.	6SN7GT
V6	Triode		S. T. C.	6J5GT
V7	Pentode		S. T. C.	6AC7
V8	Pentode		S. T. C.	6AC7
V9	Voltage stabiliser		S. T. C.	G55/1K
V10	Pentode		Mullard	EL37
V11	Pentode		Mullard	EL37
V12	F. W. Rectifier		S. T. C.	5U4G
V13	Double triode		S. T. C.	12AT7
SW1	Switch, Wafer	B261086		
SW2	Switch, Wafer	B261087		
SW3	Switch, Toggle		Arcolectric	20902 LT13
SW4	Switch, Wafer	B261089		
SW5	Switch, Wafer	B261088		
T1	Transformer L. F.	B6035		
L1	Choke L. F.		Gardners	CH240
L2	Choke L. F.		Gardners	CH299
FS1	Fuse L1055	372267	Belling & Lee	
FS2	Fuse L1055	372273	Belling & Lee	
SK1	Socket, Co-axial L604/S		Belling & Lee	
SK2	Socket, Co-axial L604/S		Belling & Lee	
SK3	Socket, Co-axial L604/S		Belling & Lee	
SK4	Socket, Co-axial L604/S		Belling & Lee	
SK5	Socket, Co-axial L604/S		Belling & Lee	
TL1	Terminal	408461		

Note: Equivalent components by other manufacturers may be fitted in some instruments.

Abbreviations:

S. T. C.	Standard Telephones and Cables
T. C. C.	Telegraph Condenser Company
G. E. C.	General Electric Company
W. W.	Wire Wound
H. S.	High Stability
M. F.	Metal Film
Pa	Paper
Po	Polystyrene
M. P.	Metalised Paper
M. Pl	Metalised Plastic
Ce	Ceramic
El	Electrolytic

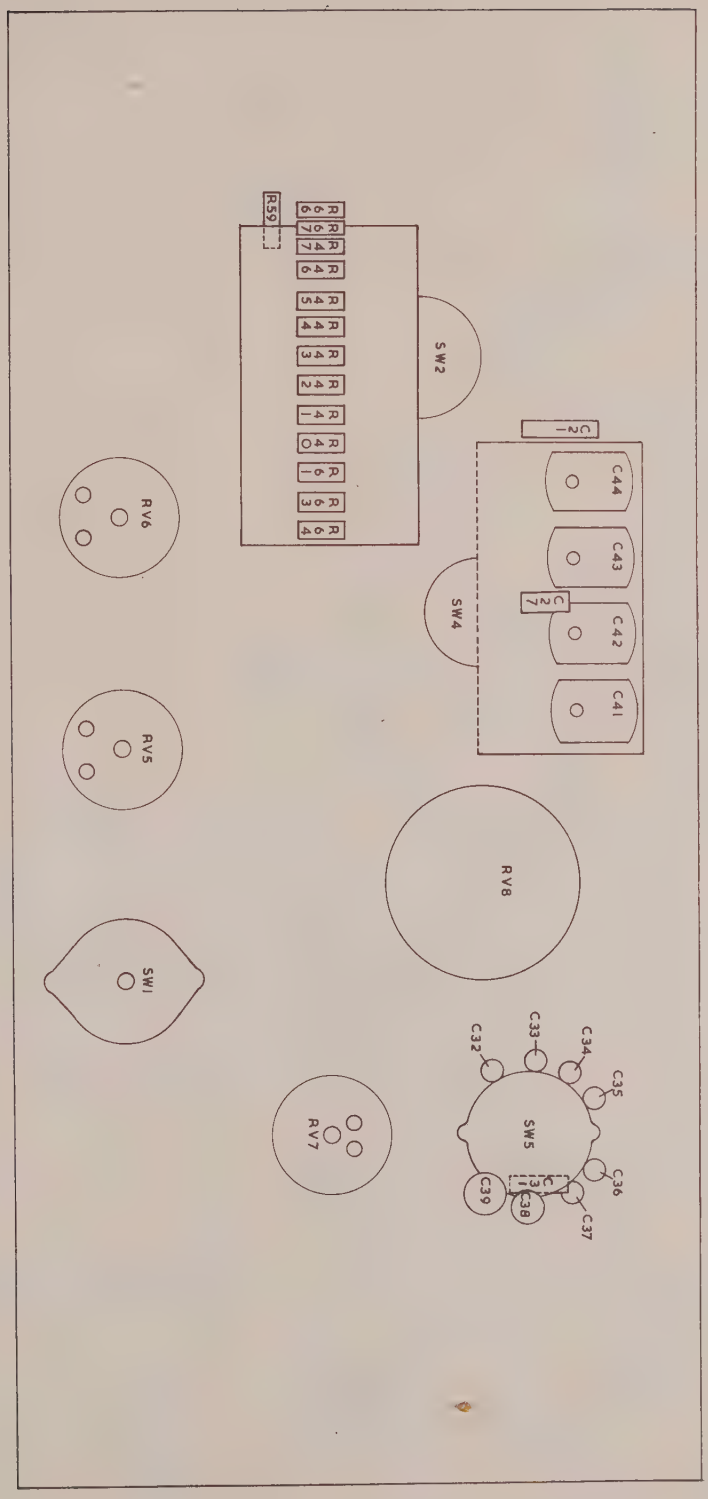


Fig. 3. Rear View of Front Panel

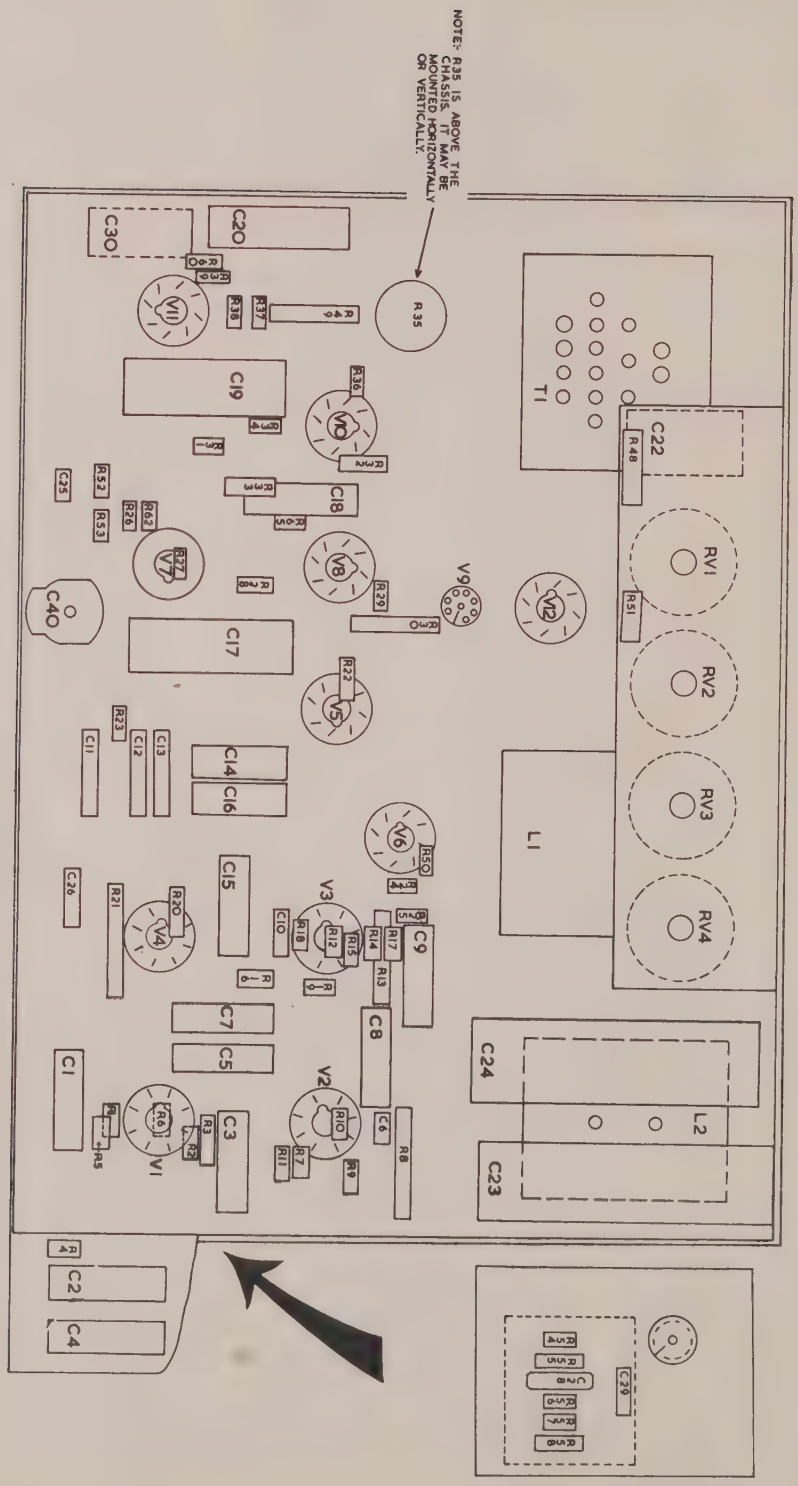
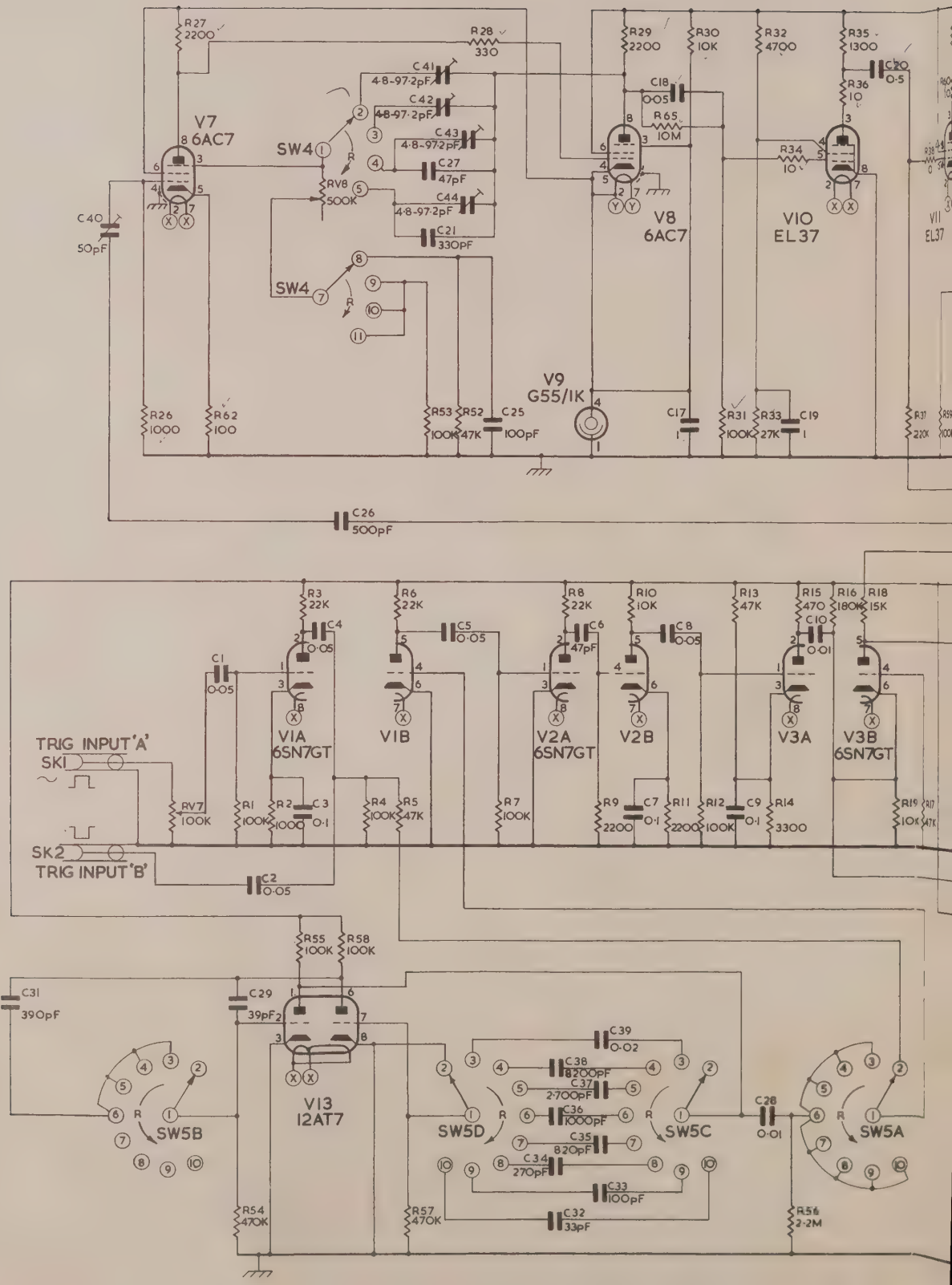
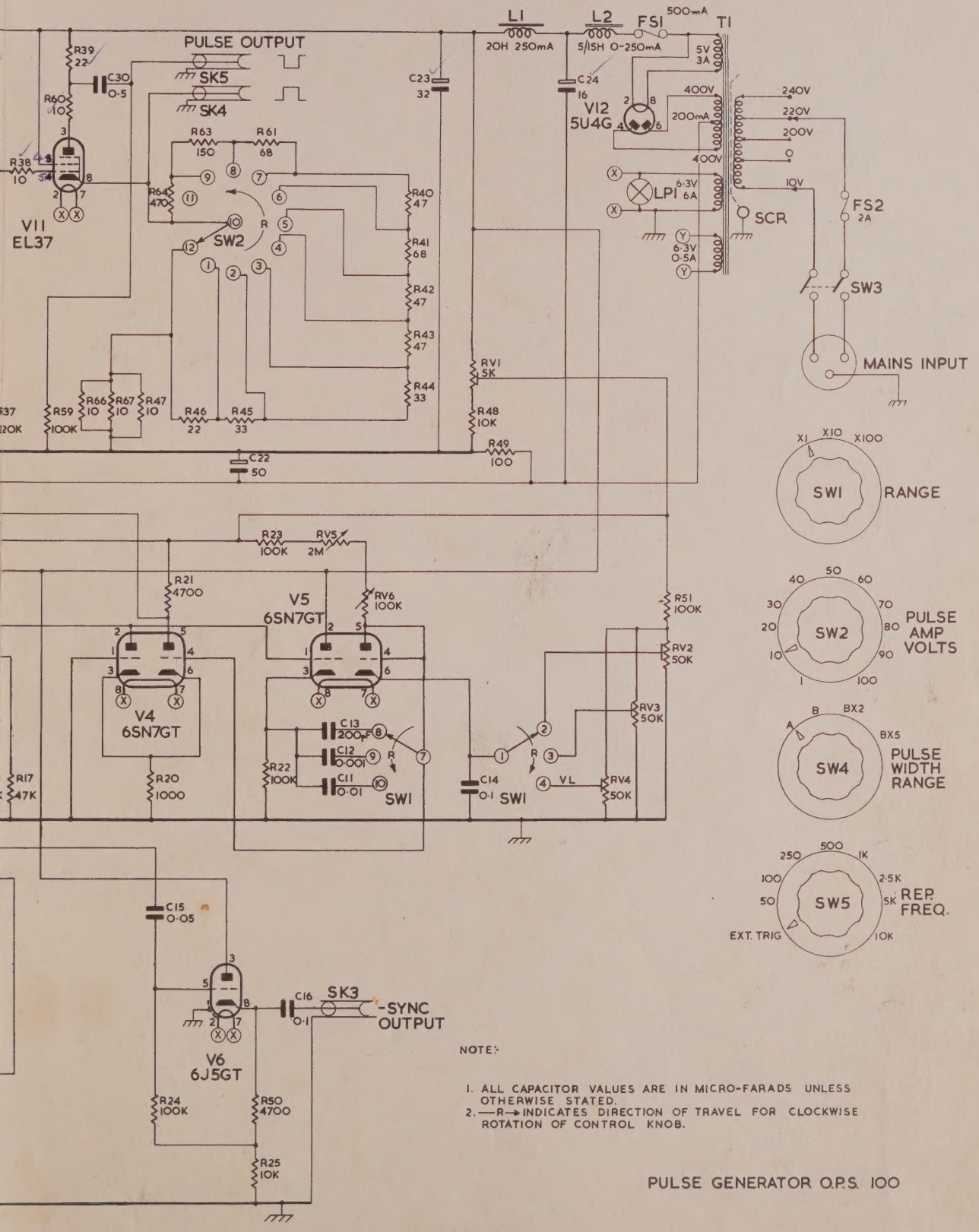


Fig. 4. Underside View of Chassis


R27 2200
R28 330
C41 4-8-97-2pF
C42 4-8-97-2pF
C43 4-8-97-2pF
C27 47pF
C44 4-8-97-2pF
C21 330pF
V7 6AC7
SW4
RV8 500K
C40 50pF
SW4
R29 2200
R30 10K
C18 0·05
R65 10M
V8 6AC7
R32 4700
R35 1300
C20 0·5
R36 10
R34 10
V10 EL37
V11 EL37
V9 G55/1K
R26 1000
R62 100
R53 100K
R52 47K
C25 100pF
C17 1
R31 100K
R33 27K
C19 1
C26 500pF
R3 22K
R6 22K
R8 22K
R10 10K
R13 47K
R15 470
R16 180K
R18 15K
C1 0·05
C4 0·05
C5 0·05
C6 47pF
C8 0·05
C10 0·01
V1A 6SN7GT
V1B
V2A 6SN7GT
V2B
V3A
V3B 6SN7GT
TRIG INPUT 'A'
SK1
SK2
TRIG INPUT 'B'
RV7 100K
R1 100K
R2 1000
C3 0·1
R4 100K
R5 47K
R7 100K
R9 2200
C7 0·1
R11 2200
R12 100K
C9 0·1
R14 3300
R19 10K
R17 47K
C2 0·05
R55 100K
R58 100K
C31 390pF
C29 39pF
V13 12AT7
SW5B
SW5D
SW5C
SW5A
C39 0·02
C38 8200pF
C37 2700pF
C36 1000pF
C35 820pF
C34 270pF
C33 100pF
C32 33pF
C28 0·01
R54 470K
R57 470K
R56 2·2M



NOTE:

1. ALL CAPACITOR VALUES ARE IN MICRO-FARADS UNLESS OTHERWISE STATED.
2. —R→ INDICATES DIRECTION OF TRAVEL FOR CLOCKWISE ROTATION OF CONTROL KNOB.

PULSE GENERATOR O.P.S. 100

Fig. 5. Circuit Diagram

MP MASTER
MA24433